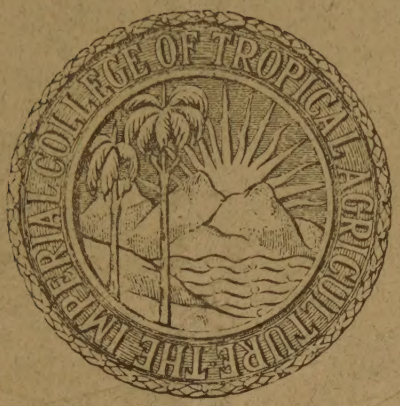
MEMOIRS

OF THE

IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, TRINIDAD.

MYCOLOGICAL  SERIES

Via colendi haud facilis.

No. 3.

OBSERVATIONS ON CYPRE (*Cordia Alliodora L.*) IN TRINIDAD WITH SPECIAL REFERENCE TO CANKER DISEASE (*Puccinia Cordiae* (*P. Henn.*) *Arthur.*)

PART I.—MYCOLOGICAL.

BY

H. R. BRITON-JONES, D.Sc., Ph.D., D.I.C., A.R.C.S.

PART II.—SILVICULTURAL.

BY

R. C. MARSHALL, M.A. (Oxon), Dip. For.

SEPTEMBER,
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OBSERVATIONS ON CYPRE.

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PART I.—MYCOLOGICAL.

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Introduction.

THE canker disease of Cypre and its causes have been known for several years and its economic importance has also been realised. In recent years, however, it has caused a great deal of damage to young plantings of Cypre in some parts of Trinidad thereby seriously interfering with the planting programme of the Forest Department. The main object of the present investigation was, therefore, to ascertain whether control of the disease was possible under forest conditions.

Historical.

Reference to previous records are somewhat confusing for various reasons, namely, (*i*) different names have been given to the host plant; (*ii*) different names have been given to the fungus which causes the smaller cankers; (*iii*) the descriptions of the symptoms of the disease in different localities do not agree. In the present account the attempt is made to clear up these points and in order to put the position, as it previously stood, as clearly as possible, the three most important records are quoted at length as follows:

Puccinia cordiae Arthur sp. November, (1).

"*Uredinia hypophyllous*, scattered, sometimes in coalescent groups of a few sori each, round, 0.2-0.4 mm. across, dark cinnamon-brown; paraphyses peripheral, hyphoid, 10-18μ by 45-75μ the wall thin, 1μ, colourless; urediniospores broadly ellipsoid or globoid, 21-25μ by 28-35μ; wall golden-brown, 1.5-2μ thick, usually thicker above, 5-12μ often somewhat thickened at hilum, closely verrucose, the pores indistinct, probably 3 or 4, equatorial.

Telia resembling uredinia but darker colour, chestnut-brown; teliospores ellipsoid, 19-26μ by 37-55μ, rounded at both ends, not constricted at septum; wall dark chestnut-brown, uniformly thick, 2.5-3μ, or slightly thicker above, very coarsely and sparsely verrucose, especially above; pedicel colourless, 6-9μ, by 30-40μ, hygroscopic near base, swelling in water to 20μ in diameter.

On Ehretiaceae:

Cordia alliodora (R. & Pav.) Cham., January, 1911, E. W. D. Holway.

A rust on Cordia sp. from Peru has been described by Henning under the name Uredo cordiae (Hedwigia 43: 163. 1904). The morphological characters are similar, but in habit it is said to produce gall-like swellings in the leaves and shoots resulting in witches-brooms, while the material from Porto Rico shows nothing of this sort."

"*Puccinia corticola*" Arthur and Rorer sp. Nov.(2).

O. Pycnia amphigenous, rather few, seen in groups of two or three, inconspicuous, subepidermal, flask shaped, 74 to 96μ broad by 110 to 115μ high; ostiolar filaments agglutinated.

III. Telia amphigenous and caulicolous, on leaves and young twigs, few, scattered, confluent in groups of 6-8 or more, on leaf blades rounded, on midribs and stems oblong or lenticular, 0.2 to 1.3 mm. long, on trunk and branches much larger, rather early naked, dark brown, pulverulent, ruptured epidermis evident; teliospores ellipsoid, 19 to 24μ by 30 to 42μ, rounded above and below, slightly or not constricted at septum, wall cinnamon or chestnut brown, 2 to 2.5μ thick, slightly thicker at apex, coarsely or sparsely verrucose, the markings more pronounced above, pedicel colourless, fragile.

On Cordia gerascanthus, L. (*Ehretiaceae*), Arima Forest Reserve, December, 1915, Rorer.

The host, Mr. Rorer writes is "a timber tree, which yields a wood known as Cypre. The disease is of economic importance here, as it not only attacks the leaves and young twigs, but the older branches as well, and causes large lesions on the main trunk of the tree." This interesting short cycle species is the only rust in *Puccinia* known to attack the trunks and larger branches of trees, although some species of *Gymnosporangium* show such behaviour."

"*Puccinia cordiae*" (P. Henn.) Arth. (*on Ehretiaceae*). (3).

Cordia gerascanthus L. (*C. alliodora* Cham.) Escuintla, Feb. 18, 1916, O, II_1, ii_2, III, 503; same, Feb. 19, 1916, ii_2, III, 508. At the time this species was described by the writer (*Mycologia* 8; 17. 1916), no collection answering to Henning's description of *Uredo cordiae* (Hedwigia 43: 163. 1904) had been seen. Number 503 of Professor Holway's material bears all spore forms from pycnia to telia belonging to the species, thus completing our knowledge of the life cycle. The primary uredinia correspond exactly to Henning's description, which brings his name into synonymy. Primary uredinia are also shown in Sydow's Uredineen 2098. They differ from secondary uredinia in having slightly larger urediniospores, in absence of paraphyses, and in causing marked hypertrophy, as well as in the presence of pycnia. The pycnia are amphigenous or caulicolous, in groups or scattered over more or less deformed terminal leaves, conspicuous, and subepidermal. The secondary uredinia are scattered over the under side of the leaf, without causing hypertrophy. They have hyphoid, peripheral paraphyses, and, of course, are not accompanied by pycnia."

The Host.

References to various flora show that there has been some confusion of names in the genus Cordia due to the fact that there are two species of *Cordia gerascanthus*. Britton and Wilson (4) give as synonyms the following names:—

Cerdana alliodora R. and P. Fl. Per. 2: 47. 1799.

Cordia gerascanthus, Jacq. Sel. Stirp. Amer. 43. 1763, Not L. 1759.

Cordia alliodora Cham. Linnaea 8: 121. 1833.

In regard to distribution, wood properties, and popular names they state "Forest, river valleys and hillsides, Porto Rico, at lower and middle elevations; ascending to about 900 m.; Vieques; St. Thomas; St. Jan; Tortola; Cuba; Hispaniola; Antigua to Trinidad; continental tropical America. The light brown wood, valued for furniture and for construction, is strong and durable. CAPA. CAPAW. SPANISH ELM."

In a contribution from the United States National Herbarium concerning the Flora of Mexico (5) the following synonyms are in agreement with the foregoing Flora—

"*Cordia alliodora* (Ruiz and Pav.) Cham. Linnaea 8. 121. 1833.

Cordia gerascanthus Jacq. Stirp. Amer. 43. 1763. Not *C. gerascanthus*, L. 1759.

Cerdana alliodora Ruiz and Pav. Fl. Peruv. Chil. 2: 47. pl. 184. 1799.

Sinaloa to Oaxaca and Tobasco. West Indies; Central and South America."

The descriptions of the plant in the above two Flora agree very closely except in one particular. Britton and Wilson describe the corolla as being about as long as the calyx, whereas in the Flora of Mexico it is stated that the corolla is twice as long as the calyx.

In the Flora of Mexico (5) *Cordia gerascanthus* L. Syst. Nat. ed. 10. 936. 1759, is given as a synonym of *Cordia gerascanthoides* H.B.K. Nov. Gen. and Sp. 3: 69. 1819, with it's distribution as Yucatan; reported from Tobasco; Greater Antilles. This presumably is a species distinct from *Cordia alliodora* L. since in the former the flowers are described as dense cymes whereas in the latter they are large panicles. *Cordia alliodora* L. is also the name given by Freeman and Williams (5) to the timber tree popularly known in Trinidad as Cyp or Cypre. These writers give the maximum height as 90 feet and maximum diameter at three feet. Britton and Wilson (4) and the Flora of Mexico (5) give 20 feet as the maximum height. This is a point of importance in the description of a valuable timber tree since the measurements given by Freeman and Williams (6) more correctly indicate it's greater economic possibilities.

The Fungus.

From the above it appears, therefore, that the fungus *Puccinia corticola* Arthur and Rorer was found on *C. alliodora* L. or *C. gerascanthus* Jacq. and not on *C. gerascanthus* L. as recorded by Rorer (2). Thus we have two rust fungi recorded on *C. alliodora* L., namely *P. corticola* Arthur and Rorer, and *Puccinia cordiae*(P. Henn.) Arthur, with *Uredo cordiae* Henning as a synonym of the latter. Reference to the foregoing descriptions of the fungi show that there is no difference between the Teluto-stages of *P. corticola* Arthur and Rorer and the Teluto-stage of *Puccinia cordiae* (P. Henn.) Arthur. For some time *Uredo cordiae* Henning although similar morphologically was considered distinct from the Uredo-stage of *Puccinia cordiae* Arthur because they were thought to be different in their effect on the host plant. On *Cordia sp.* in Peru it is said to cause witches-brooms whereas in Porto Rico it does not causes witches-brooms. This, however, is due, as will be shown later, to a misconception of the cause of witches-brooms in *C. alliodora* L. We are thus brought to the conclusion that the primary cause of canker in Cypre (*C. alliodora* L.) in Trinidad has at present two names. Following the laws of priority the fungus should be known as *Puccinia cordiae* (P. Henn.) Arthur with *Puccinia corticola* Arthur and Rorer and *Uredo cordiae* Henning as synonyms.

OBSERVATIONS ON CYPRE.

PLATE I.

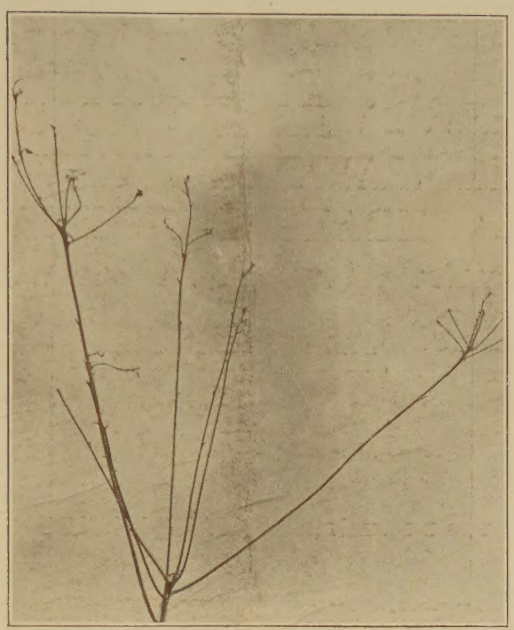

FIG. 1.

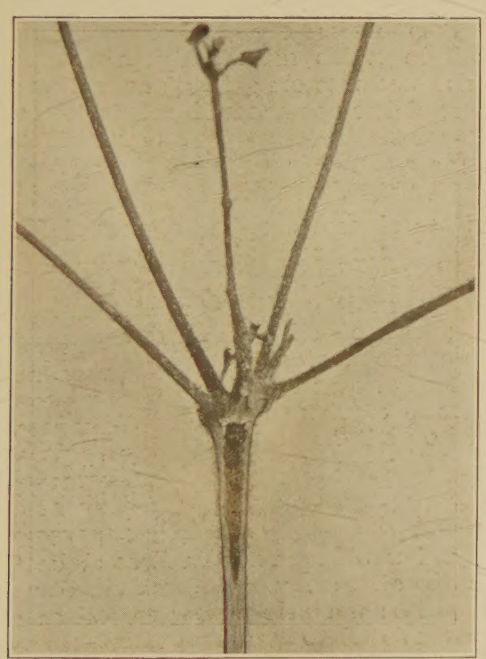

FIG. 2.

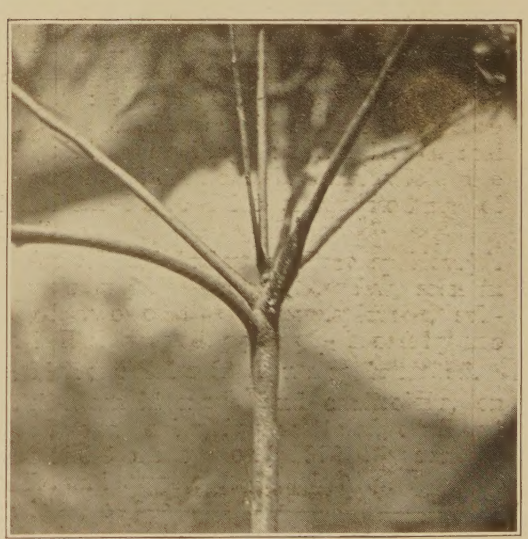

FIG. 3.

PLATE II.

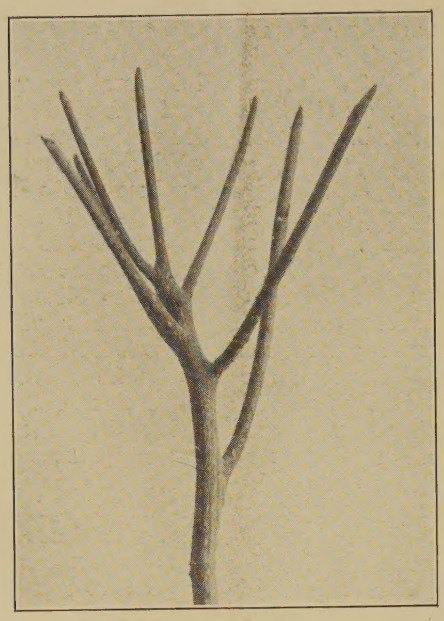

FIG. 1.

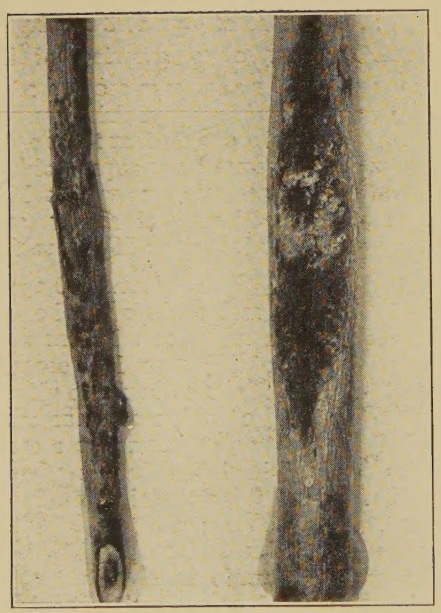

FIG. 2.

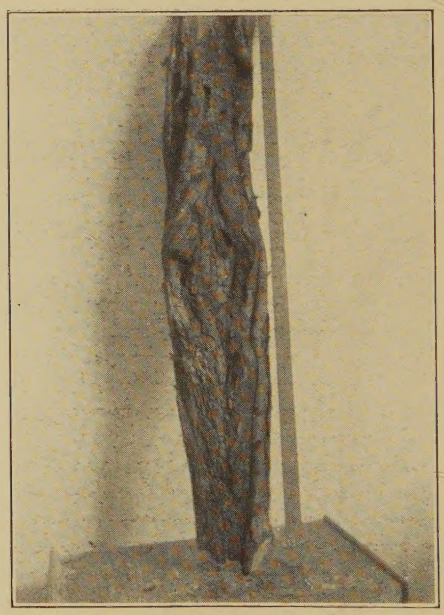

FIG. 3.

Description of the Disease.

As with the names of host and parasite previous descriptions of this disease are misleading. Rorer states that this is the only rust in the genus *Puccinia* which attacks the main trunk and larger branches of the tree. The fungus is also said to cause witches-brooms on the tree. The present writer's observations on these two points are as follows :—

Witches-brooms.

The witches-brooms are produced (Plate I, Figs. 1 to 3) as the result of a shortening of the internodes near the growing points of the youngest branches and the outgrowth of the buds in the axils of the young leaves to produce shoots. Such witches-brooms are present on every Cypre tree examined in Trinidad and include those which suffer to various degrees from canker (Plate I, Fig. 3) and those which are quite free from canker (Plate I, Figs. 1 to 2 and Plate II, Fig. 1). Careful examination of the growing points of the several branches show that at different periods in their growth they are slightly swollen before the axillary buds begin to grow out. A longitudinal section at this stage shows that the internal tissue is brown in colour and this discolouration may extend downwards in the pith to a length of 1½ inches. The discoloured tissue is found on dissection to be burrowed by one or more tiny caterpillars of different ages and sizes. As many as four of these caterpillars have been found in one shoot. The largest of them may measure about a third of an inch in length. The caterpillar is whitish in colour, soft and delicate, with a hardened dark brown head. It has no true legs. These appear to be modified to form soft podia suggestive of those on the hinder segments of looper caterpillars. Short hairs are present on the segmented body. This caterpillar sometimes produces fine silken threads and causes a cavity inside the swollen green shoot as the result of its feeding. Later this cavity is more or less filled with the caterpillar's faeces. It is a caterpillar of one of the Microlepidoptera but beyond what has been stated the life history has not been worked out nor has the imago been seen or identified. As the result of the burrowing of the internal tissues of the young shoots the stem at this point becomes swollen and later the axillary buds are stimulated to grow out into side shoots, hence the witches-broom. Later various species of ants are attracted to the cavity which they clean out and use as breeding places. The ants enter through a tiny hole which appears to be the exit hole of the parasite. The occurrence of the caterpillar parasite is so constant in Cypre in Trinidad that it largely decides the mode of branching of the tree. The writer has not seen a single tree which is not attacked. For this reason it is difficult to state whether it's presence affects the tree adversely or not. In a number of cases the tiny caterpillar starts to bore at the base of a leaf petiole which swells up in consequence. It later bores it's way into the stem tissues. The young leading shoot sometimes dies back after it has grown to a length of three inches or so following the time of infection and is replaced by one of the side branches. This however, is not general. The proximity of the witches-brooms one to the other on the branches depends to some extent on the rate of growth of the branches (Plate I, Fig. 1). The faster the branches are growing the wider apart the witches-brooms are, but, nevertheless, they are quite general in their occurrence all over the tree from a young stage to those fully matured.

The Small Cankers.

Cankers caused by *Puccinia cordiae* (P. Henn.) Arthur may occur on young green shoots three or four inches long but this is the exception rather than the rule. The frequency of the occurrence of the cankers on these very young shoots depends on the age of the plant and the locality in which it is grown. This is explained later. Cankers bearing *P. cordiae* T-spores also occur on upright unbranched shoots but most frequently occur on the bases of the branches comprising the witches-brooms. (Plate I, Fig. 3.) The Teluto-sori can be found on these young cankers on branches and trunks up to three-quarters of an inch in diameter. The fungus attacks the cortical tissues mainly since at quite a young stage the wood underlying the unattacked bark round the outside edge of that invaded by *P. cordiae* is brown in colour, dead and invaded by other fungi. The largest canker on which *P. cordiae* fructifications have been found is two and a half inches long. The growth of *P. cordiae* on the host branches is slow and the stem becomes swollen on the unattacked side. This is the case with many other cankers caused by different species of fungi and is due to the stimulated growth of the side of the branch opposite the canker and to callous formation. As the branch gets older and over three quarters of an inch in diameter, and very often before that thickness is reached, the advance of the fungus *P. cordiae* is cut off as the result of callous formation. This results in an open wound since the cortical tissues previously attacked by *P. cordiae* are chored off. When these small cankers are sufficiently numerous they cause a general dying back of the younger branches. Most frequently it is the Teluto-stage that is found on the branches and this is the stage which is also most common on the leaf veins and laminae. The Teluto-stage examined by the writer agrees with Arthur's description and spore measurements of *Puccinia cordiae*. The writer's range of spore measurements is 18 to 30 μ by 27 to 48 μ. The sori are often confluent and are grouped in few or large numbers depending on the age of the canker. For some months no stage other than the Teluto-stage was found and after many searches it was decided to examine diseased material minutely once a month, since it was felt that the other stages would be produced at different seasons of the year, or that it might prove to be a heteroecious rust. At the beginning of February, material collected both in the South

this reserve seems to be of the nature of a pre-climax, following the destruction of, or the effect of fire on, ordinary mixed type forest. The canopy is far more open and the forest is definitely of a dryer type, akin rather to a semi-deciduous than to the tropical rain forest.

In this forest the chief crop formers are *Trichilia oblanceolata* (Acurel) and *Brosimum* sp. (Moussara), while the following are locally abundant, *Bravaisia floribunda*, D.C. (Jiggerwood), *Hura crepitans*, L. (Sandbox), and *Peltogyne porphyrocardis*, Gr. (Purpleheart). *Cedrela mexicana* Roem. (Cedar), while not abundant, yet occurs fairly prominently throughout the association. Carat palm (*Sabal glaucescens* Lodd) is abundant throughout the association. In the Northern Range of Trinidad *Cordia alliodora* Cham. is found in the ordinary type of mixed forest which occurs on poor soils, in association with *Lecythis laevifolia* Griseb (Guatacre), *Tabebuia serratifolia* Don. (Poui), *Lauraceae*, spp., *Diplotropis brachpetala* (Black-heart), *Vitex divaricata*, Sw. (Black fiddlewood), *Didymopanax Morototoni* Dene and Pl. (Jereton), *Sterculia cariboea*, R. Br. (Mahoe), *Mimusops balata var cruegeri*, Pierre (Balata), &c., &c.

Silvicultural Characteristics.

Cypre is a strong light demander. Although it will stand a slight shade, for optimum development it needs full overhead light. It possesses a well developed root system and stands exposure well. One frequently sees more or less isolated trees doing well on dry hillsides. Young and medium sized trees coppice quite well, but not old trees. The production of root suckers is sometimes very marked.

Under favourable conditions cypre is an exceptionally rapid growing tree. The annual rings in most cases, are marked by narrow bands of darker coloured tissue. A height of 20 feet in three years is not unusual. In the Southern Watershed Reserve a 15 year old tree had a height of 70 feet, with a girth of two feet 11 inches at breast height.

Germination is usually good within a few weeks, and no especial difficulty has been met with in establishing plantations. Early growth is rapid, seed is plentiful and cheap and direct sowing is feasible.

The Cypre Canker.

Cypre plantations have been formed in Trinidad in the Northern (Arima Reserve and River Estate), the Southern Watershed Reserve near Siparia and in the Central Range Reserve. In all of these areas canker has been observed, it being particularly bad in the Arima Reserve. There is no available evidence to show at what date these plantations were first attacked, but, when I came to the Colony in 1923, there were many trees up to two feet in girth which were very badly cankered, and had the appearance of having been first attacked at least four or five years previously. From the forestry standpoint this is an extremely serious disease, as the canker eats its way into the stem and either kills the tree directly, or indirectly, through the stem becoming weakened and being blown down. Trees are frequently attacked in several places and it is the exception for a tree to form a callus over the diseased portion.

Control Measures.

From the evidence which has been detailed elsewhere by Dr. Briton-Jones it is evident that cypre canker is primarily due to a parasitic rust fungus *Puccinia cordiae* (P. Henn.) Arth. which completes its life cycle on *Cordia alliodora*, Cham.

This fungus is not a wound parasite but attacks healthy young living tissue. The prevention of attack must therefore depend on growing cypre under conditions inimical to the development of this fungus. In other words it is essential to choose airy, open spaces and to avoid moist humid hollows. This fortunately fits in well with the general silvicultural characteristics of the tree as it is, by nature, a tree of the hills and stands exposure well.

In plantations early thinning is indicated. This in turn points to the need of an evergreen understory for soil protection purposes. It is necessary to remember that although a sufficiently wide spacing is desirable in order to provide airy conditions against cypre canker, a wide spacing, unless care is taken, leads to soil deterioration and the invasion of the area by weeds and grass. The best counter to this lies in the introduction of a low growing understory.

It is suggested that an initial spacing of not less than six feet by six feet be adopted. By removing alternate trees in alternate rows this would be altered to about eight and a half feet by eight and a half feet giving each tree twice the growing space it occupied formerly. A first thinning, approximating to the above, might well take place when the crop is only three or four years old. It is however undesirable to attempt to lay down rules. Only the general idea can be here indicated and commonsense must be used in applying it in the field.

The Timber.

Cypre is one of the leading softwoods in the Colony. It is a buff to light brown coloured wood often with darker markings, weighing about 38 lb. per cubic foot when air dry. It is easy to work, yet tough and strong, and durable when not in contact with the ground.

Cypre seasons well quickly ; shrinkage is small, a board one foot wide showing a shrinkage of one fifth of an inch.

The timber is greatly in demand locally for building construction and furniture. It makes excellent floors, doors, &c., and in fact is a thoroughly useful medium weight wood. The wood polishes well and is also used for boat timbers, oars and in motor car bodies.

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